PATENT COOPERATION TREATY

From the INTERNATIONAL BUREAU

PCT

NOTIFICATION OF ELECTION

(PCT Rule 61.2)

To:

Assistant Commissioner for Patents
United States Patent and Trademark Office
Box PCT
Washington, D.C.20231
ÉTATS-UNIS D'AMÉRIQUE

in its capacity as elected Office

Date of mailing (day/month/year) 10 August 1999 (10.08.99)	
International application No. PCT/AU98/01077	**Applicant's or agent's file reference** 21668
International filing date (day/month/year) 24 December 1998 (24.12.98)	**Priority date** (day/month/year) 24 December 1997 (24.12.97)
Applicant MURDOCH, Graham, Alexander, Munro et al	

1. The designated Office is hereby notified of its election made:

[X] in the demand filed with the International Preliminary Examining Authority on:

20 July 1999 (20.07.99)

[ ] in a notice effecting later election filed with the International Bureau on:

2. The election [X] was

[ ] was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

The International Bureau of WIPO **34, chemin des Colombettes** **1211 Geneva 20, Switzerland**	Authorized officer S. Mafla
Facsimile No.: (41-22) 740.14.35	Telephone No.: (41-22) 338.83.38

Form PCT/IB/331 (July 1992)

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PATENT COOPERATION TREATY

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INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference 21668	**FOR FURTHER ACTION**	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416).
International application No. **PCT/AU98/01077**	International filing date *(day/month/year)* 24 December 1998	Priority Date *(day/month/year)* 24 December 1997
International Patent Classification (IPC) or national classification and IPC **Int. Cl.** [7] H04B 1/59, H04L 27/20		
Applicant PARAKAN PTY LTD et al.		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 3 sheets, including this cover sheet.

☐ This report is also accompanied by ANNEXES, i.e., sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of sheet(s).

3. This report contains indications relating to the following items:

I	☒	Basis of the report
II	☐	Priority
III	☐	Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
IV	☐	Lack of unity of invention
V	☒	Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
VI	☐	Certain documents cited
VII	☐	Certain defects in the international application
VIII	☐	Certain observations on the international application

Date of submission of the demand	Date of completion of the report
20 July 1999	2 March 2000
Name and mailing address of the IPEA/AU AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA E-mail address: pct@ipaustralia.gov.au Facsimile No. (02) 6285 3929	Authorized Officer **J. LAW** Telephone No. (02) 6283 2179

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.
PCT/AU98/01077

I. Basis of the report

1. With regard to the **elements** of the international application:*

☐ the international application as originally filed.

☒ the description, pages **1, 4-10,** as originally filed,
pages , filed with the demand,
pages **2,3, 3a 11,** filed with the letter of **23 February 2000**.

☒ the claims, pages , as originally filed,
pages , as amended (together with any statement) under Article 19,
pages , filed with the demand,
pages **12-16,** filed with the letter of .

☒ the drawings, pages **1-5,** as originally filed,
pages , filed with the demand,
pages , filed with the letter of .

☐ the sequence listing part of the description:
pages , as originally filed
pages , filed with the demand
pages , filed with the letter of .

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.
These elements were available or furnished to this Authority in the following language which is:

☐ the language of a translation furnished for the purposes of international search (under Rule 23.1(b)).

☐ the language of publication of the international application (under Rule 48.3(b)).

☐ the language of the translation furnished for the purposes of international preliminary examination (under Rules 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, was on the basis of the sequence listing:

☐ contained in the international application in written form.

☐ filed together with the international application in computer readable form.

☐ furnished subsequently to this Authority in written form.

☐ furnished subsequently to this Authority in computer readable form.

☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

4. ☐ The amendments have resulted in the cancellation of:

☐ the description, pages

☐ the claims, Nos.

☐ the drawings, sheets/fig.

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).**

* *Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17).*

** *Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report*

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Claims	**1-34**	**YES**
	Claims		**NO**
Inventive step (IS)	Claims	**1-34**	**YES**
	Claims		**NO**
Industrial applicability (IA)	Claims	**1-34**	**YES**
	Claims		**NO**

2. Citations and explanations (Rule 70.7)

Claims 1-34

The invention of the amended claims is a method of data transmission, where a phase modulation is imposed on a carrier signal such that the amplitude of the sidebands of the modulated signal is substantially lower than that of the carrier.

No individual citation or combination of citations disclose the above modulation method.

The closest art of:

US 4899158 A

shows a responder of a moving object discriminating system which receives, processes and answers signal transmitted from the interrogator. The answer signal transmitted from the responder to the interrogator is phase modulated by data stored in the responder.

WO 99/34526
PCT/AU98/01077

PATENT COOPERATION TREATY

From the INTERNATIONAL BUREAU

PCT

To:
BALDWIN SHELSTON WATERS
60 Margaret Street
Sydney, NSW 2000
AUSTRALIE

NOTICE INFORMING THE APPLICANT OF THE COMMUNICATION OF THE INTERNATIONAL APPLICATION TO THE DESIGNATED OFFICES

(PCT Rule 47.1(c), first sentence)

Date of mailing (day/month/year) 08 July 1999 (08.07.99)	
Applicant's or agent's file reference 21668 16 JULY 99	**IMPORTANT NOTICE**

International application No.	**International filing date** (day/month/year)	**Priority date** (day/month/year)
PCT/AU98/01077	24 December 1998 (24.12.98)	24 December 1997 (24.12.97)

Applicant
PARAKAN PTY. LTD. et al

1. Notice is hereby given that the International Bureau has communicated, as provided in Article 20, the international application to the following designated Offices on the date indicated above as the date of mailing of this Notice:
   AU,CN,EP,IL,JP,KP,KR,US

   In accordance with Rule 47.1(c), third sentence, those Offices will accept the present Notice as conclusive evidence that the communication of the international application has duly taken place on the date of mailing indicated above and no copy of the international application is required to be furnished by the applicant to the designated Office(s).

2. The following designated Offices have waived the requirement for such a communication at this time:
   AL,AM,AP,AT,AZ,BA,BB,BG,BR,BY,CA,CH,CU,CZ,DE,DK,EA,EE,ES,FI,GB,GD,GE,GH,GM,HR,HU,
   ID,IN,IS,KE,KG,KZ,LC,LK,LR,LS,LT,LU,LV,MD,MG,MK,MN,MW,MX,NO,NZ,OA,PL,PT,RO,RU,SD,
   SE,SG,SI,SK,SL,TJ,TM,TR,TT,UA,UG,UZ,VN,YU,ZW
   The communication will be made to those Offices only upon their request. Furthermore, those Offices do not require the applicant to furnish a copy of the international application (Rule 49.1(a-bis)).

3. Enclosed with this Notice is a copy of the international application as published by the International Bureau on
   08 July 1999 (08.07.99) under No. WO 99/34526

REMINDER REGARDING CHAPTER II (Article 31(2)(a) and Rule 54.2)

If the applicant wishes to postpone entry into the national phase until 30 months (or later in some Offices) from the priority date, **a demand for international preliminary examination** must be filed with the competent International Preliminary Examining Authority before the expiration of 19 months from the priority date.

It is the applicant's sole responsibility to monitor the 19-month time limit.

Note that only an applicant who is a national or resident of a PCT Contracting State which is bound by Chapter II has the right to file a demand for international preliminary examination.

REMINDER REGARDING ENTRY INTO THE NATIONAL PHASE (Article 22 or 39(1))

If the applicant wishes to proceed with the international application in the **national phase**, he must, within 20 months or 30 months, or later in some Offices, perform the acts referred to therein before each designated or elected Office.

For further important information on the time limits and acts to be performed for entering the national phase, see the Annex to Form PCT/IB/301 (Notification of Receipt of Record Copy) and Volume II of the PCT Applicant's Guide.

The International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland
Facsimile No. (41-22) 740.14.35

Authorized officer
J. Zahra
Telephone No. (41-22) 338.83.38

BALDWIN SHELSTON WATERS
SYDNEY NSW 2000

Speed Dial 508

Contact: Jeffrey Sweetman

The International Preliminary Examining Authority
Australian Patent Office
PO Box 200
WODEN ACT 2606

PCT Patent Application No. PCT/AU98/01077
Applicant: PARAKAN PTY LTD AND ILAMON PTY LTD AND MAGELLAN TECHNOLOGY PTY LIMITED
Our reference: 21668.00 JBS.jt

FIRST STATEMENT OF AMENDMENTS

Complete Specification

Description

1. Cancel page 2 now on file and replace with new page 2 attached herewith.

Claims

2. Cancel pages 12 and 13 now on file and replace with new pages 12 and 13 attached herewith.

DATED this 6th day of October 1999
PARAKAN PTY LTD AND ILAMON PTY LTD AND
MAGELLAN TECHNOLOGY PTY LIMITED

Additionally, regulations governing the magnitude of electromagnetic emissions place upper limits on the strength of excitation fields that can be used and the allowable bandwidth of an excitation field. The wide bandwidth of the prior art pulse, modulation data results in limitations being placed on the maximum excitation field strength.

DISCLOSURE OF THE INVENTION

It is an object of the invention, at least in the preferred embodiment, to overcome or at least substantially ameliorate one or more of the disadvantages of the prior art.

According to one aspect of the invention there is provided a method for transmitting data from a first antenna, said method including the steps of:

providing a carrier signal;

imposing a phase modulation of less than 90° on the carrier signal in accordance with a data signal to create a modulated signal;

providing the modulated signal to said first antenna for transmission.

According to a second aspect of the invention there is provided a transmitter including:

a first antenna;

oscillator means for providing a carrier signal; and

mixing means for imposing a phase modulation of less than 90° on the carrier signal in accordance with a data signal to create a modulated signal, the mixing means also providing the modulated signal to the first antenna for transmission.

Preferably, the modulated signal is received by a second antenna which in response thereto, produces a first signal which is provided to receiver means, the

CLAIMS

1. [AMENDED] A method for transmitting data from a first antenna, said method including the steps of:

providing a carrier signal;

imposing a phase modulation of less than 90° on the carrier signal in accordance with a data signal to create a modulated signal;

providing the modulated signal to said first antenna for transmission.

2. A method according to claim 1 including the step of receiving the modulated signal with a second antenna which, in response thereto, produces a first signal which is provided to receiver means, the receiver means deriving a second signal indicative of the data signal.

3. A method according to claim 2 wherein the first signal is used to power the receiver means.

4. A method according to claim 2 or claim 3 wherein both the first and second antennas have a high Q factor.

5. A method according to claim 1 including the step of deriving the modulated signal from the sum of the carrier signal and an attenuated quadrature carrier signal which is modulated with the data signal.

6. [AMENDED] A transmitter including:

a first antenna;

oscillator means for providing a carrier signal; and

mixing means for imposing a phase modulation of less than 90° on the carrier signal in accordance with a data signal to create a modulated signal, the mixing means also providing the modulated signal to the first antenna for transmission.

7. A transmitter according to claim 6 wherein the modulated signal is received by a second antenna which, in response thereto, produces a first signal which is provided to receiver means, the receiver means deriving a second signal indicative of the data signal.

8. A transmitter according to claim 7 wherein the first signal is used to power the receiver means.

9. A transmitter according to any one of claim 6 to 8 wherein both the first and second antennas have a high Q factor.

10. A transmitter according to claim 6 wherein the modulated signal includes the sum of the carrier signal and an attenuated quadrature carrier signal which is modulated with the data signal.

11. A transmitter according to claim 6 wherein the antenna is a tunable coil.

12. A method for transmitting data from an antenna substantially as herein described with reference to the embodiment of the invention illustrated in the accompanying drawings.

13. A transmitter substantially as herein described with reference to the embodiment of the invention illustrated in the accompanying drawings.

14. An identification system including a transmitter as defined in any one of claims 6 to 11.

15. A system according to claim 14 for identifying luggage.

BALDWIN SHELSTON WATERS
SYDNEY NSW 2000

Speed Dial 508

Contact: Jeffrey Sweetman

The International Preliminary Examining Authority
Australian Patent Office
PO Box 200
WODEN ACT 2606

Re: PCT Application No. PCT/AU98/01077
Applicant: PARAKAN PTY LTD; ILAMON PTY LTD; and MAGELLAN TECHNOLOGY PTY LIMITED
Our Ref: 21668.00 JBS.jt

SECOND STATEMENT OF AMENDMENTS

Complete Specification

Description

3. Cancel pages 2, 3 and 11 now on file and replace with new pages 2, 3, 3a and 11 attached herewith.

Claims

4. Cancel pages 12 to 13 now on file and replace with new pages 12 to 16 attached herewith.

DATED this 23rd day of February, 2000
PARAKAN PTY LTD; ILAMON PTY LTD; and
MAGELLAN TECHNOLOGY PTY LIMITED

by.....
Fellow Institute of Patent and Trade Mark Attorneys of Australia of BALDWIN SHELSTON WATERS

Additionally, regulations governing the magnitude of electromagnetic emissions place upper limits on the strength of excitation fields that can be used and the allowable bandwidth of an excitation field. The wide bandwidth of the prior art pulse, modulation data results in limitations being placed on the maximum excitation field strength.

Disclosure of the Invention

It is an object of the invention, at least in the preferred embodiment, to overcome or substantially ameliorate at least one of the disadvantages of the prior art.

According to one aspect of the invention there is provided a method for transmitting data from a first antenna, said method including the steps of:

providing a carrier signal;

imposing a low level phase modulation on the carrier signal in accordance with a data signal to create a modulated signal;

providing the modulated signal to said first antenna for transmission.

According to a second aspect of the invention there is provided a transmitter including:

a first antenna;

oscillator means for providing a carrier signal; and

mixing means for imposing a low level phase modulation on the carrier signal in accordance with a data signal to create a modulated signal, the mixing means also providing the modulated signal to the first antenna for transmission.

Preferably, the modulated signal is received by a second antenna which in response thereto, produces a first signal which is provided to receiver means, the

receiver means deriving a second signal indicative of the data signal. Even more preferably, the first signal is used to power the receiver means.

In a preferred form, the modulated signal includes the sum of the carrier signal and an attenuated quadrature carrier signal which is modulated with the data signal. This form of modulation is described herein as phase jitter modulation (PJM).

In a preferred form the antenna is a tunable coil. Preferably also, both the first and second antennas have a high Q factor.

According to another aspect of the invention there is provided an identification system including a transmitter as described above.

Preferably, the system is for identifying luggage.

Brief Description of the Drawings

The prior art and a preferred embodiment of the invention will now be described, by way of example only, with reference to the accompanying drawings in which:

Figure 1 is a schematic illustration of a prior art transponder circuit;

Figure 2 illustrates representative waveforms associated with the prior art circuit of Figure 1;

Figures 3(a) to 3(c) are frequency spectra associated with the waveforms of the prior art circuit of Figure 1;

Figures 4(a) and 4(b) are phasor diagrams for waveforms produced in accordance with the invention;

Figures 5(a) to 5(c) are frequency spectra associated with the invention;

filter off the sidebands on the input signal The output of the schmitt is passed through a chain of invertors designed to add a fixed delay to the input signal. The delay is approximately chosen so that the phase of the output from the delay chain is not 0° or 180° with respect to the LO. A preferred phase value is 90° for circuit convenience. The output of the VCO acts as the LO to demodulate the Phase Jitter Modulated data. The data is demodulated in an exclusive OR gate, the output of which is low pass filtered and detected with a floating comparator.

Although the invention has been described with reference to a specific example it will be appreciated by those skilled in the art that it may be embodied in many other forms.

CLAIMS:-

1. A method for transmitting data from a first antenna, said method including the steps of:

providing a carrier signal;

imposing a low level phase modulation on the carrier signal in accordance with a data signal to create a modulated signal; and

providing the modulated signal to said first antenna for transmission.

2. A method according to claim 1 including the step of receiving the modulated signal with a second antenna which, in response thereto, produces a first signal which is provided to receiver means, the receiver means deriving a second signal indicative of the data signal.

3. A method according to claim 2 wherein the first signal is used to power the receiver means.

4. A method according to claim 2 or claim 3 wherein both the first and second antennas have a high Q factor.

5. A method according to claim 1 including the step of deriving the modulated signal from the sum of the carrier signal and an attenuated quadrature carrier signal which is modulated with the data signal.

6. A transmitter including:

a first antenna;

oscillator means for providing a carrier signal; and

mixing means for imposing a low level phase modulation on the carrier signal in accordance with a data signal to create a modulated signal, the mixing means also providing the modulated signal to the first antenna for transmission.

7. A transmitter according to claim 6 wherein the modulated signal is received by a second antenna which, in response thereto, produces a first signal which is provided to receiver means, the receiver means deriving a second signal indicative of the data signal.

8. A transmitter according to claim 7 wherein the first signal is used to power the receiver means.

9. A transmitter according to any one of claims 6 to 8 wherein both the first and second antennas have a high Q factor.

10. A transmitter according to claim 6 wherein the modulated signal includes the sum of the carrier signal and an attenuated quadrature carrier signal which is modulated with the data signal.

11. A transmitter according to claim 6 wherein the antenna is a tunable coil.

12. A method for transmitting data from an antenna substantially as herein described with reference to the embodiment of the invention illustrated in the accompanying drawings.

13. A transmitter substantially as herein described with reference to the embodiment of the invention illustrated in the accompanying drawings.

14. An identification system including a transmitter as defined in any one of claims 6 to 11.

15. A system according to claim 14 for identifying luggage.

PCT

WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 :
H04B 1/59, H04L 27/20

A1

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PP 1112 24 December 1997 (24.12.97) AU

(71) Applicants *(for all designated States except US)*: PARAKAN PTY. LTD. [AU/AU]; 65 Johnston Street, Annandale, NSW 2038 (AU). ILAMON PTY. LTD. [AU/AU]; 24 Northumberland Avenue, Stanmore, NSW 2048 (AU). MAGELLAN TECHNOLOGY PTY. LTD. [AU/AU]; 65 Johnston Street, Annandale, NSW 2038 (AU).

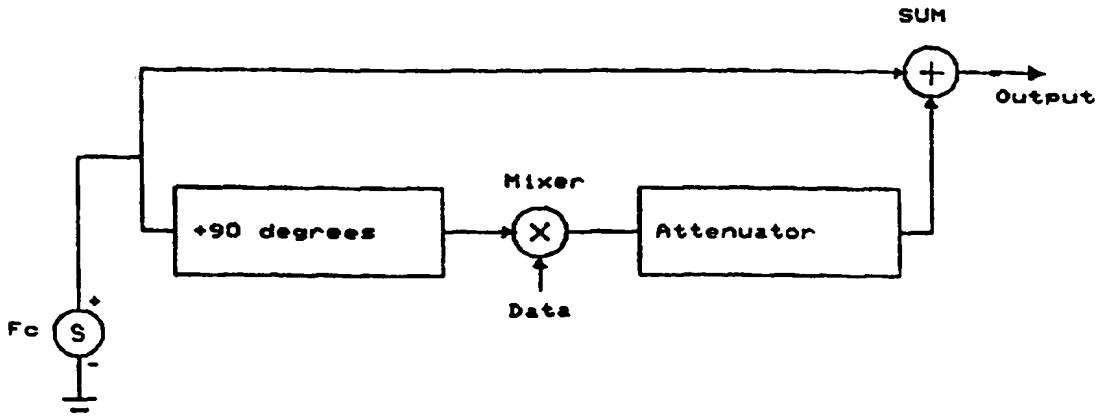
(72) Inventors; and
(75) Inventors/Applicants *(for US only)*: MURDOCH, Graham, Alexander, Munro [AU/AU]; 103 Albion Street, Annandale, NSW 2038 (AU). LITTLECHILD, Stuart, Colin [AU/AU]; 24 Northumberland Avenue, Stanmore, NSW 2048 (AU).

(74) Agent: BALDWIN SHELSTON WATERS; 60 Margaret Street, Sydney, NSW 2000 (AU).

(81) Designated States: AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published
With international search report.

(54) Title: A TRANSMITTER AND A METHOD FOR TRANSMITTING DATA



Method of Modulating Excitation Signal

(57) Abstract

An excitation reference source (Fc) is split through a 90 degree splitter. One output from the splitter is fed to the LO port of a mixer. Data is fed to the mixer's IF port and causes PRK modulation of the LO port's signal. The output of the mixer at the RF port is a PRK modulated quadrature signal. This is attenuated and added back onto the reference by a zero degree combiner ready for transmission to the transponder.

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TITLE: **A TRANSMITTER AND A METHOD FOR TRANSMITTING DATA**

Field of Invention

The invention relates to a transmitter and a method for transmitting data.

The invention has been developed primarily for the field of radio frequency identification (RFID), and more particularly to a method for transmitting data to a transponder with a single antenna, and will be described hereinafter with reference to that application. This invention has particular merit when applied to passive transponders where high speed data transmission is desirable.

Background of the Invention

Hitherto, high speed data has been transmitted to RFID transponders by modulation of the excitation field. Generally pulse position modulation with 100% depth amplitude modulation of the excitation field is used. The excitation field is turned off for short intervals which are detected by the transponder's processing circuitry. To achieve high data rates while maintaining the transmission of power the intervals must be short and the duty cycle low. Typically a duty cycle of 10% is used and the intervals are 1μs long and the average time between intervals is 10μs. Short intervals such as these have a wide bandwidth. Accordingly, both the interrogator and the transponder require low Q factor, wide bandwidth antennae to transmit and receive the data. Low Q factor antennae are not energy efficient and, as such, the interrogator antenna will consume more power than a high Q factor antenna. Moreover, for passive transponders a stronger excitation field is required to compensate for the less efficient antenna.

Additionally, regulations governing the magnitude of electromagnetic emissions place upper limits on the strength of excitation fields that can be used and the allowable bandwidth of an excitation field. The wide bandwidth of the prior art pulse, modulation data results in limitations being placed on the maximum excitation field strength.

Disclosure of the Invention

It is an object of the invention, at least in the preferred embodiment, to overcome or substantially ameliorate at least one of the disadvantages of the prior art.

According to one aspect of the invention there is provided a method for transmitting data from a first antenna, said method including the steps of:

providing a carrier signal;

imposing a low level phase modulation on the carrier signal in accordance with a data signal to create a modulated signal;

providing the modulated signal to said first antenna for transmission.

According to a second aspect of the invention there is provided a transmitter including:

a first antenna;

oscillator means for providing a carrier signal; and

mixing means for imposing a low level phase modulation on the carrier signal in accordance with a data signal to create a modulated signal, the mixing means also providing the modulated signal to the first antenna for transmission.

Preferably, the modulated signal is received by a second antenna which in response thereto, produces a first signal which is provided to receiver means, the

receiver means deriving a second signal indicative of the data signal. Even more preferably, the first signal is used to power the receiver means.

In a preferred form, the modulated signal includes the sum of the carrier signal and an attenuated quadrature carrier signal which is modulated with the data signal. This form of modulation is described herein as phase jitter modulation (PJM).

In a preferred form the antenna is a tunable coil. Preferably also, both the first and second antennas have a high Q factor.

According to another aspect of the invention there is provided an identification system including a transmitter as described above.

Preferably, the system is for identifying luggage.

Brief Description of the Drawings

The prior art and a preferred embodiment of the invention will now be described, by way of example only, with reference to the accompanying drawings in which:

Figure 1 is a schematic illustration of a prior art transponder circuit;

Figure 2 illustrates representative waveforms associated with the prior art circuit of Figure 1;

Figures 3(a) to 3(c) are frequency spectra associated with the waveforms of the prior art circuit of Figure 1;

Figures 4(a) and 4(b) are phasor diagrams for waveforms produced in accordance with the invention;

Figures 5(a) to 5(c) are frequency spectra associated with the invention;

Figures 6(a) and 6(b) respectively illustrate methods of encoding and decoding data in accordance with the invention;

Figure 7 is a schematic illustration of a preferred circuit for encoding the data signal for transmission; and

Figure 8 is a schematic illustration of a preferred circuit for decoding the data signal in the transponder.

Detailed Description of a Preferred Embodiment of the Invention

Passive RFID transponders that incorporate a single antenna are interrogated by an interrogator using an excitation field. This field is received by the transponder's antenna and the voltage induced on the antenna is rectified and used to power the transponder. Often it is necessary for the transponder to receive data transmitted from its interrogator. For single antenna transponders the received messages must be received by the same antenna that is used to receive the excitation signal used to power the transponder. In prior art systems the excitation signal is amplitude modulated to convey messages from the interrogator to the transponder.

Figure 1 shows a prior art transponder where the antenna L is tuned by a capacitor C and data is transmitted to the transponder by amplitude modulation. The voltage V1 induced in the transponder's antenna coil is magnified by the antenna's tuning, rectified by the rectifiers and stored on the DC storage capacitor Cdc for use by the transponder's electronic circuits. The antenna voltage is peak level detected by the diode envelope detector D1, C1 and R1 to give the envelope voltage V2.

Figures 2(a) and 2(b) illustrate waveforms associated with the prior art circuit of Figure 1. More particularly, Figure 2(a) shows the excitation voltage V1 with

amplitude intervals to giving pulse position modulation. To deliver the maximum power to the transponder, a low duty cycle is used, typically 10:1. Figure 2(b) shows the envelope of the voltage V2 induced in the antenna. The antenna's transient response results in a finite rise and fall time for V2. The transient time of the antenna must be sufficiently short to allow narrow pulses to pass without significant distortion. The antenna's transient response time constant Ts and bandwidth BW are related by $Ts=1/(BW.\pi)$. Accordingly, to pass short pulses the bandwidth of the antenna must be broad. For example, to pass 1μs pulses a bandwidth of at least 1 MHz is required.

Figures 3(a) to 3(c) are frequency spectra associated with the prior art circuit of Figure 1. Figure 3(a) shows a typical data spectrum. For data at 100 kbps the first zero of the frequency spectrum occurs at 100 kHz. Figure 3(b) shows the data spectrum when encoded as pulse position modulation PPM where narrow low duty cycle pulses are used. The spectrum for this type of encoding is much broader than the original data spectrum. For 1μs pulses with a 10:1 duty cycle the first amplitude zero of the frequency spectrum occurs at 1 MHz. Figure 3(c) shows the spectrum of the excitation signal when modulated with the PPM signal whose spectrum is shown at Figure 3(b). The modulated spectrum is double sided and accordingly, for 1μs pulses with a 10:1 duty cycle the width of the main spectral lobe is 2 MHz. Clearly the bandwidth of the PPM modulated excitation signal is much broader than the original data spectrum.

To pass the inherently broad band PPM excitation signal both the interrogator and transponder antenna must have a wide bandwidth. Consequently the interrogator and transponder antennae must have a low Q and will operate with a low efficiency. In

the interrogator the generation of 100% amplitude modulated PPM requires that excitation signal be completely quenched for each pulse. This requires a wide band low efficiency antenna. Narrow band antennae would operate with high efficiency but are unable to respond to the narrow amplitude pulses of PPM. Similarly the transponder antenna bandwidth must be broad band enough to pass the modulated excitation signal. Broad band antennae are inherently low Q and are poor collectors of energy from an excitation field.

In this preferred embodiment of the invention data is imposed as a low level signal having a modulated quadrature component. Most preferably this modulation is phase modulation although in other embodiments use is made of amplitude modulation. In the present embodiment the low level signal appears as a tiny phase jitter in the excitation field. There is no change in the amplitude of the excitation field and hence the transmission of power to the transponder is unaffected. This form of modulation will be termed phase jitter modulation or, for convenience, PJM.

There are many methods of producing small modulated phase shifts. For example, by passing the signal through a phase shifter such as an RC or tuned circuit, or through a variable length delay line.

In this embodiment, to produce the signal at the interrogator, a small portion of the excitation signal is phase shifted 90 degrees to give a quadrature signal. This is then PRK modulated with the data signal and added back onto the original excitation signal before being transmitted to the transponder. The resultant signal can be amplitude limited to remove any residual amplitude component. At the transponder these tiny phase shifts in the excitation induce corresponding antenna voltage phase

shifts that are unaltered by any circuit impedances or power regulation circuitry connected to the transponder's antenna.

Figure 4(a) is a phasor diagram of the excitation signal Fc and the modulated quadrature signal PRK. The amplitude of the respective signals are given by their phasor lengths. The phase deviation THETA caused by the modulated quadrature signal is, for low level signals, extremely small and is given by:

$$THETA = \arctan (2xMag(PRK)/Mag(Fc))$$

For a 40 dB attenuated PRK signal THETA = 1.2 degrees and for a 60 dB attenuated PRK signal THETA = 0.12 degrees. Both of these are extremely small phase deviations of the excitation signal.

Phase quadrature modulation is recovered using a local oscillator (LO) signal, with a fixed phase with respect to the excitation signal, to down convert the modulated data to baseband in a mixer or multiplier. In the transponder the LO signal must be derived from the modulated excitation signal. The preferred method of extracting a LO signal from the modulated excitation signal uses a Phase Locked Loop PLL in the transponder to generate the LO signal. The LO signal is generated by a low loop bandwidth PLL which locks to the original excitation signal's phase but is unable to track the high speed modulated phase shifts. The quadrature data signal is down converted and detected in a mixer or multiplier driven with the LO signal. Depending upon the type of phase detector used in the PLL, and the propagation delays through the circuit, the phase of the LO with respect to the excitation signal can be anywhere between 0° and 360°. If a conventional XOR phase detector is used in the PLL then the output of the PLL oscillator will be at nominally 90 degrees to the excitation signal

and will be in phase with the data modulated phase quadrature signal. A 90° phase between the LO and the excitation signal is not necessary for the effective detection of quadrature phase modulation. An XOR mixer has a linear phase to voltage conversion characteristic from 0° to 180° and 180° to 360°. Hence it gives the same output amplitude irrespective of the phase angle except around 0° and 180° where there is a gain sign change.

The average output voltage DC level from a mixer is a function of the average phase difference between its inputs. It is more convenient for circuit operation for the average output to be around midspan and hence an LO with a phase angle of around 90° is more convenient. The phase of the LO signal can be simply adjusted using fixed phase delay elements. Hence a 0° or 180° phase detector can be used and a further 90° (roughly) of phase shift can be achieved with a fixed delay element.

Figure 4(b) is a phasor diagram of the modulated excitation signal and a quadrature local oscillator signal in the transponder used to demodulate the data signal. The local oscillator signals phase is at 90 degrees with respect to the excitation signal's phase.

For phase modulation the data bandwidth is no broader than the original double sided data bandwidth. When attenuated the level of the modulated data spectrum is extremely low with respect to the excitation signal amplitude making conformance to regulatory emission limits significantly easier than with the prior art.

Figures 5(a) to 5(c) are representative frequency spectra that explain the operation of the invention. More particularly, Figure 5(a) is a typical data spectrum. For data at 100 kbps the first zero of the frequency spectrum occurs at 100 kHz. Figure

5(b) is a representative frequency spectrum of the data when modulated onto a quadrature version of the excitation signal. The spectrum for this type of modulation is the same as the double sided spectrum of the original data spectrum. In the invention the modulated quadrature signal is attenuated and added to the original excitation signal. Figure 5(c) shows the spectrum of the excitation signal Fc plus the attenuated modulated quadrature signal whose spectrum is shown in Figure 5(b). The attenuation level is given by the difference between the amplitude of the excitation signal and the amplitude of the data sidebands.

Since the spectrum of the transmitted excitation signal is equal to the original double sided data spectrum, narrow band high Q interrogator and transponder antennae are used to respectively transmit and receive the modulated excitation signal. Consequently, the interrogator's excitation antenna operates with high efficiency and the transponder's antenna likewise receives energy with high efficiency. In other embodiments use is made of low Q antennae.

Figures 6(a) and 6(b) show methods of modulating and demodulating according to this invention. Turning first to Figure 6(a), the portion of the main excitation signal is phase shifted 90 degrees to produce a quadrature signal. The quadrature signal is then modulated with data. The preferred form of modulation is phase reverse keying PRK. The PRK modulated quadrature signal is attenuated and then added back to the main excitation signal. Although shown in a particular order the sequence phase shift, modulation and attenuation are done in other orders in alternative embodiments. This method of modulation produces low level data side bands on the excitation signal where the sidebands are in phase quadrature to the

excitation signal. The data signal appears as a low amplitude phase jitter on the excitation signal. In some embodiment the signal is further amplitude limited to remove any residual amplitude component.

Figure 6(b) illustrates a method for demodulating the data modulated on to the excitation signal. A LO signal is generated by a low loop bandwidth phase lock loop PLL. The PLL locks on to the excitation signals phase and is unable to follow the high speed phase jitter caused by the data modulation. For the standard PLL phase detector the PLL oscillator will lock at a fixed phase with respect to the excitation signal's phase. This oscillator signal is then used as a LO to demodulate the quadrature sideband data signal in the multiplier. A low pass filter LPF filters out high frequency mixer products and passes the demodulated data signal.

Figure 7 shows an example circuit for encoding the data signal for transmission. An excitation reference source Fc is split through a 90 degree splitter. One output from the splitter is fed to the LO port of a mixer. Data is fed to the mixer's IF port and causes PRK modulation of the LO port's signal. The output of the mixer at the RF port is a PRK modulated quadrature signal. This is attenuated and added back onto the reference by a zero degree combiner ready for transmission to the transponder.

Figure 8 shows an example circuit for decoding the data signal in the transponder. The transponder antenna voltage is squared up by a schmitt trigger, the output of which feeds a type 3 PLL. A type 3 phase detector is a positive edge triggered sequence phase detector which will drive the PLL oscillator to lock at 180° with respect to the input phase. With a low loop bandwidth the PLL is able to easily

filter off the sidebands on the input signal The output of the schmitt is passed through a chain of invertors designed to add a fixed delay to the input signal. The delay is approximately chosen so that the phase of the output from the delay chain is not 0° or 180° with respect to the LO. A preferred phase value is 90° for circuit convenience. The output of the VCO acts as the LO to demodulate the Phase Jitter Modulated data. The data is demodulated in an exclusive OR gate, the output of which is low pass filtered and detected with a floating comparator.

Although the invention has been described with reference to a specific example it will be appreciated by those skilled in the art that it may be embodied in many other forms.

CLAIMS:-

1. A method for transmitting data from a first antenna, said method including the steps of:

providing a carrier signal;

imposing a low level phase modulation on the carrier signal in accordance with a data signal to create a modulated signal; and

providing the modulated signal to said first antenna for transmission.

2. A method according to claim 1 including the step of receiving the modulated signal with a second antenna which, in response thereto, produces a first signal which is provided to receiver means, the receiver means deriving a second signal indicative of the data signal.

3. A method according to claim 2 wherein the first signal is used to power the receiver means.

4. A method according to claim 2 or claim 3 wherein both the first and second antennas have a high Q factor.

5. A method according to claim 1 including the step of deriving the modulated signal from the sum of the carrier signal and an attenuated quadrature carrier signal which is modulated with the data signal.

6. A transmitter including:

a first antenna;

oscillator means for providing a carrier signal; and

mixing means for imposing a low level phase modulation on the carrier signal in accordance with a data signal to create a modulated signal, the mixing means also providing the modulated signal to the first antenna for transmission.

7. A transmitter according to claim 6 wherein the modulated signal is received by a second antenna which, in response thereto, produces a first signal which is provided to receiver means, the receiver means deriving a second signal indicative of the data signal.

8. A transmitter according to claim 7 wherein the first signal is used to power the receiver means.

9. A transmitter according to any one of claims 6 to 8 wherein both the first and second antennas have a high Q factor.

10. A transmitter according to claim 6 wherein the modulated signal includes the sum of the carrier signal and an attenuated quadrature carrier signal which is modulated with the data signal.

11. A transmitter according to claim 6 wherein the antenna is a tunable coil.

12. A method for transmitting data from an antenna substantially as herein described with reference to the embodiment of the invention illustrated in the accompanying drawings.

13. A transmitter substantially as herein described with reference to the embodiment of the invention illustrated in the accompanying drawings.

14. An identification system including a transmitter as defined in any one of claims 6 to 11.

15. A system according to claim 14 for identifying luggage.

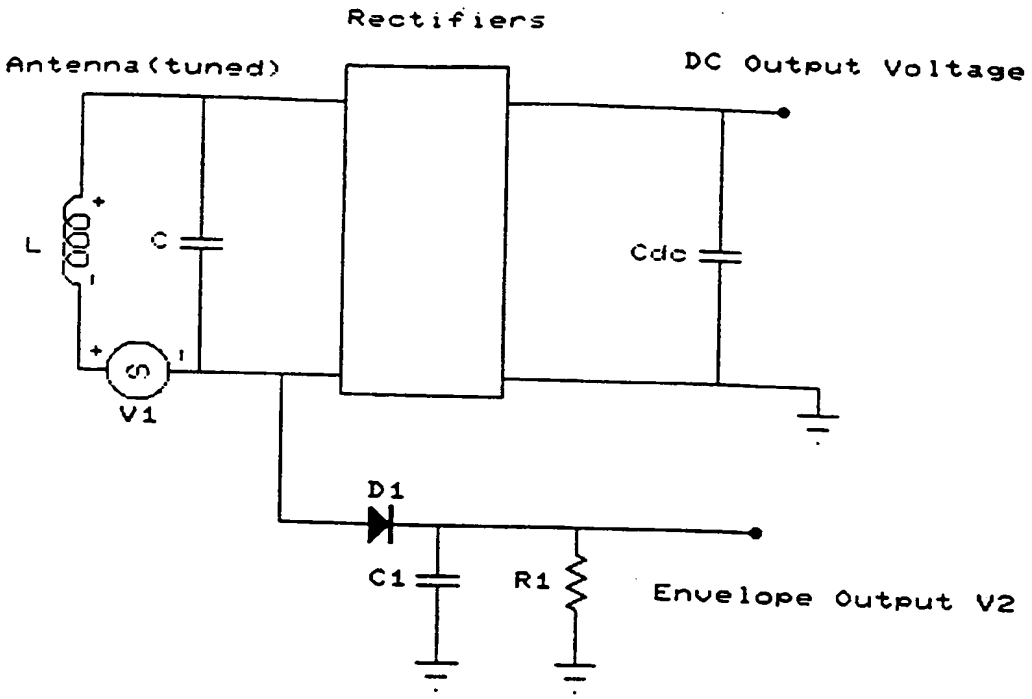

Figure 1 : Prior Art Transponder

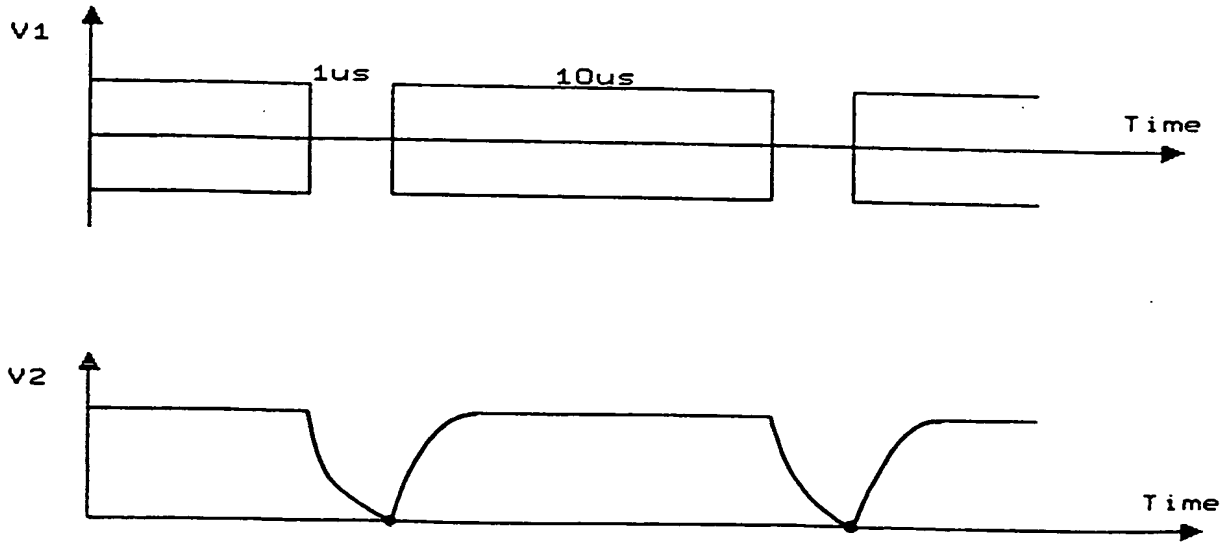

Figure 2 : Excitation V1 and Detected Envelope V2

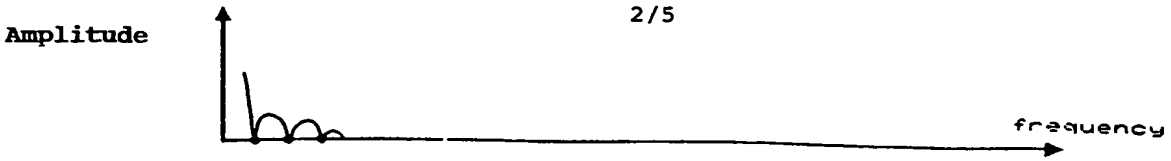

Figure 3(a) : Data Spectrum

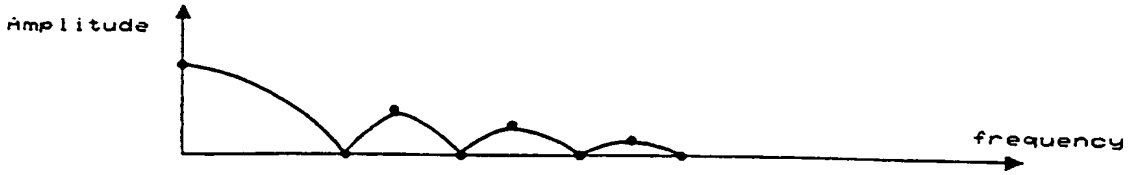

Figure 3(b) : Pulse Position Spectrum

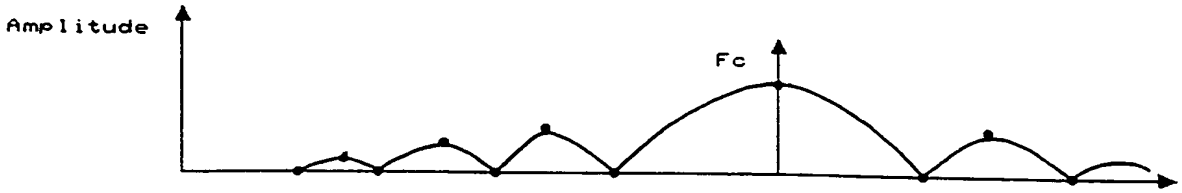

Figure 3(c) : Excitation Spectrum Modulated with PPM

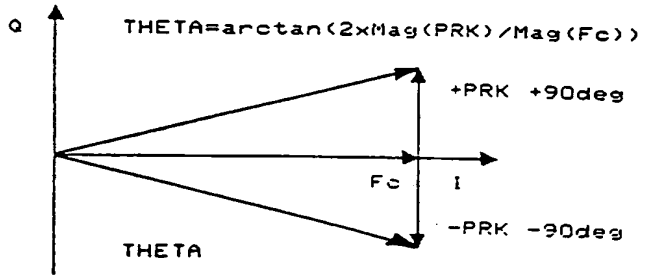

Figure 4(a) : Phasor diagram showing Excitation and Modulation

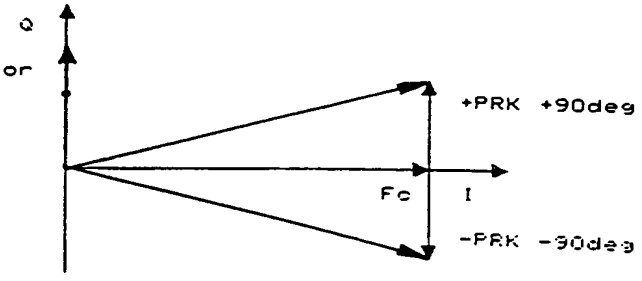

Figure 4(b) : Phasor diagram Showing Local Oscillator at 90deg to Fc

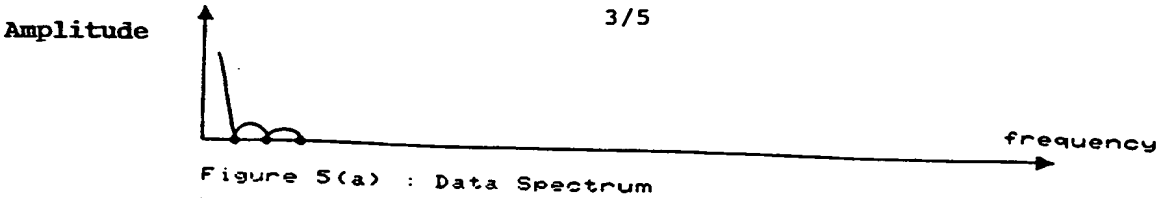

Figure 5(a) : Data Spectrum

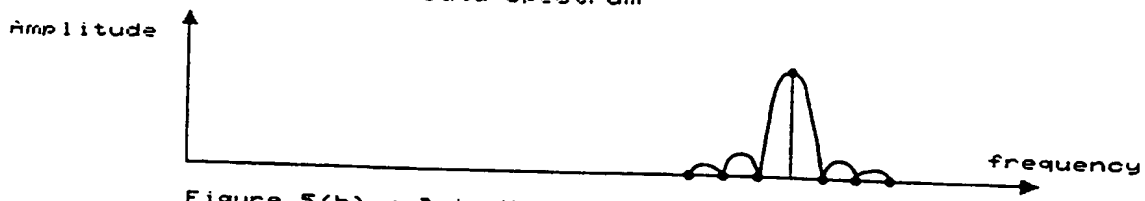

Figure 5(b) : Data Modulated Quadrature Excitation

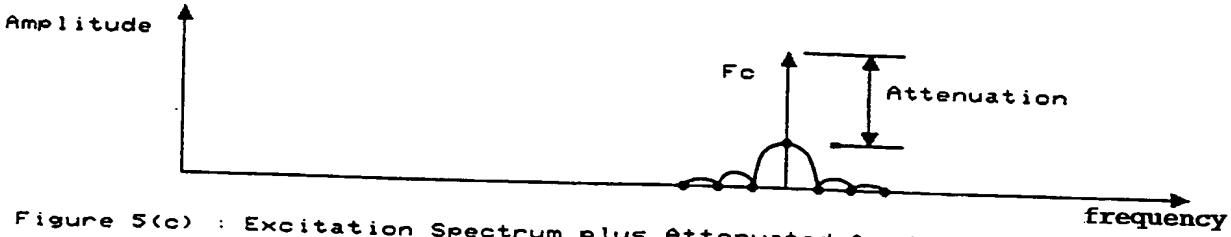

Figure 5(c) : Excitation Spectrum plus Attenuated Quadrature Modulation

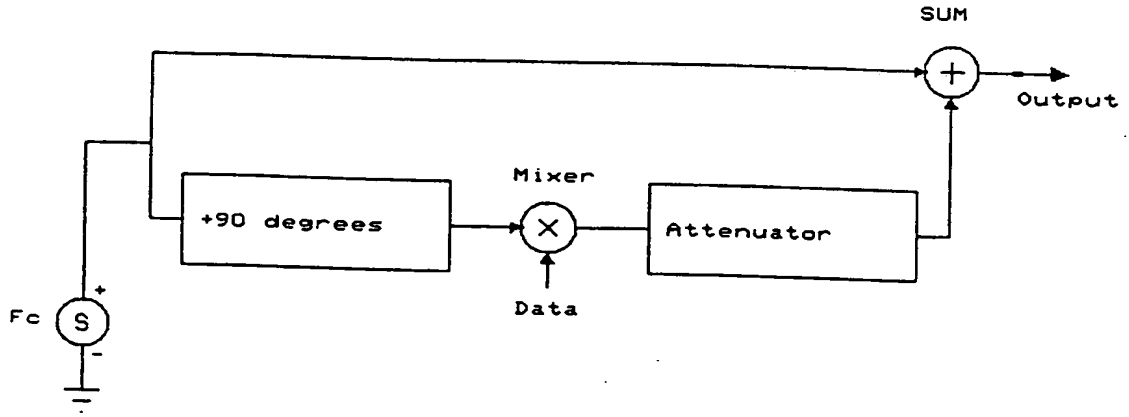

Figure 6(a) : Method of Modulating Excitation Signal

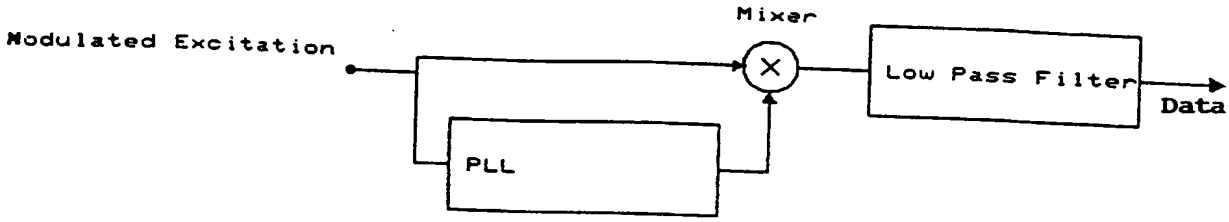

Figure 6(b) : Method of Demodulation

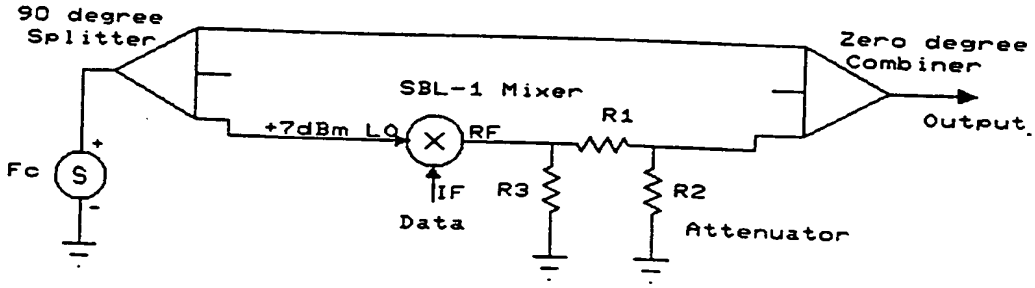

Figure 7 : Example Circuit for Modulating

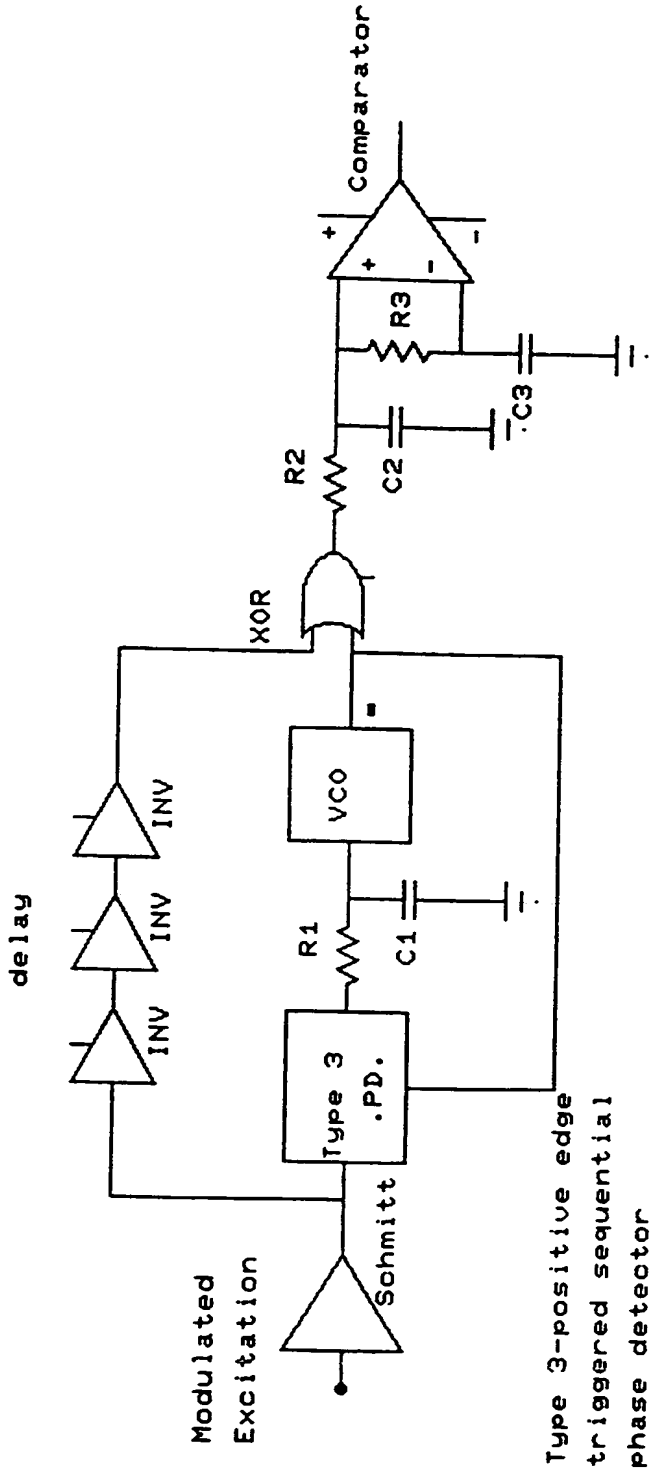

Figure 8 : Example Circuit for Demodulating

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU 98/01077

A. CLASSIFICATION OF SUBJECT MATTER

Int Cl[6]: H04B 1/59, H04L 27/20

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC: H04B, H04L, H03C, G01S

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
WPAT

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5481262 A (URBAS et al.) 2 January 1996 Column 3 line 20 - column 4 line 9	1-4, 6-9
X	US 4899158 A (SAEKI et al.) 6 February 1990 Column 2 line 58 - column 4 line 49	1, 2, 6, 7
P,X	EP 851639 A (LUCENT TECHNOLOGIES INC.) 1 July 1998 Column 3 line 9 - column 9 line 12	1-4, 6-9

[X] Further documents are listed in the continuation of Box C

[X] See patent family annex

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
20 January 1999	- 1 FEB 1999
Name and mailing address of the ISA/AU AUSTRALIAN PATENT OFFICE PO BOX 200 WODEN ACT 2606 AUSTRALIA Facsimile No.: (02) 6285 3929	Authorized officer J. LAW Telephone No.: (02) 6283 2179

INTERNATIONAL SEARCH REPORT

...ternational application No.
PCT/AU 98/01077

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
P,X	GB 2314999 A (SAMSUNG ELECTRONICS CO. LTD) 14 January 1998 Page 3 line 14 - page 4 line 14	1-4, 6-9

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/AU 98/01077

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report		Patent Family Member					
US	5481262	AU	81546/91	AU	55012/94	AU	55013/94
		CA	2048385	CH	682782	DE	4125746
		DE	4143561	FR	2667206	GB	2249001
		GB	2258588	GB	2258589	IT	1258003
		JP	2709758	JP	2747985	JP	2747986
		NZ	239190	NZ	248087	NZ	2488088
		US	5481262	US	5422636		
US	4899158	DE	3832409	FR	2621134	GB	2210538
		JP	1084175	KR	9204754	JP	2655660
		JP	2603672				
EP	851639	JP	10209914				
GB	2314999	GB	9713696				

END OF ANNEX